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FEBRUARY 22, 1988

CHEMICAL & ENGINEERING

Drug testing: how it's being handled at the Winter Olympics
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Chemical Earnings Soar

Further big gains in fourth-quarter 1987
Page 10

CHEMICAL & ENGINEERING NEWS

Volume 66, Number 8
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FEBRUARY 22, 1988

News of the Week

■ **Some federal R&D agencies, most notably NSF, fare quite well in President Reagan's proposed federal budget for fiscal 1989.** **Page 4**

■ **House subcommittee concludes that White House Office of Science & Technology is operating satisfactorily, considering the political problems it faces.** **Page 5**

■ **Several top-level Soviet scientists attending U.S. meeting describe Soviet research in their fields, outline sweeping reforms now under way as part of perestroika.** **Page 5**

■ **New optical data storage medium, called "digital paper" by developer ICI Electronics, can store vastly more data than current disks and tapes, may revolutionize the computer industry as well as audio and video applications.** **Page 6**

■ **Researchers successfully test system that allows genetic engineers to monitor altered organisms in the environment to follow their distribution and evaluate their performance.** **Page 6**

Government

EPA's final rule on toxic chemical release reporting requires annual reports on environmental releases of 308 specific chemicals and 20 categories of chemicals. **Page 16**

Clause in recently passed spending bill mandates that carbon fiber producers secure at least 50% of their polyacrylonitrile raw materials from U.S. sources by 1992. **Page 17**

Science

Two new classes of macromolecules are synthesized using branching strategies that allow construction of a large molecule with precisely controlled size, shape, and molecular weight. **Page 19**

Technology

Drug testing at Winter Olympic Games in Calgary targets stimulants, narcotics and analgesics, anabolic steroids, beta blockers, and diuretics. **Page 23**

Books

"Coal: the Energy Source of the Past and Future," by Harold H. Schobert, considers the feasibility of coal as compared with other alternative energy sources. **Page 26**

ACS News

ACS urges changes to House chemical diversion bill, which is aimed at stopping the diverting of chemicals from their legitimate purposes to the making of illegal drugs. **Page 28**

Cover: Degussa's hydrogen peroxide plant in Theodore, Ala.

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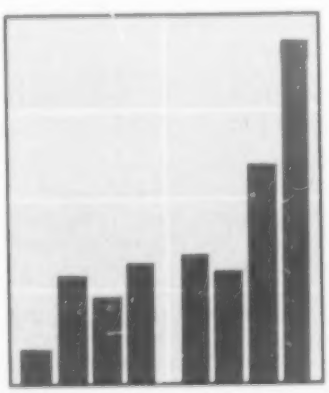

Business

Capping a strong year, major chemical companies' earnings shot up 93% on a sales increase of 20% in fourth-quarter 1987; profitability reached 6.7%, up from 4.2% in fourth-quarter 1986. **Page 10**

Chemical & Engineering News

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LETTERS

Patenting vaccines

SIR: I was surprised to read in your article on animal health products the assertion attributed to William H. D. Leaning that "vaccines themselves cannot be patented" (C&EN, Oct. 5, 1987, page 51). This would come as a surprise to patent attorneys, who have been patenting vaccines for some time. For example, U.S. Patent No. 3,470,294 has claims directed to a composite vaccine against canine distemper and hepatitis.

I recently received a notice of the allowance of an application on a vaccine against an insect-borne disease for a scientist at the University of Minnesota.

Warren D. Woessner
Patent Attorney, Minneapolis

Editor's note: C&EN should have made clear that William H. D. Leaning was referring to a specific case in which Merck was unable to patent a vaccine it developed in cooperation with the U.S. Department of Agriculture.

Cancer prevention

SIR: In the provocative article, "Rethinking the War on Cancer" (*Issues in Science and Technology*, Fall 1987, page 16), John C. Bailar III warns that we are losing the war against cancer. As he points out, our failure to lower the U.S. cancer death rate, despite an effort spanning 35 years, shows the need for a change in strategy.

To comprehend this revelation it is useful to probe the trends in U.S. cancer death rates. Information on this subject was also supplied by Bailar in a previous publication entitled "Progress Against Cancer" [*N. Engl. J. Med.*, **314**, 1226 (1986)]. There he reports that the cancer mortality rates, age-adjusted to the U.S. population of 1980—excluding lung cancer, cancer of the stomach, and cancer of the cervix—shifted from 130.1 in 1950 to 128.9 in 1980, a change of less than 1% in three decades.

It is this situation that prompted Bailar to declare, "It is difficult to claim success in the war against cancer on the basis of these figures." It was also this situation that prompted J. Cairns, a decade ago, to state in "Cancer: Science and Society": "For example, in the U.S., there has been little change in the incidence and death rate from cancer as a whole in the last 30 years during which time the annual production of pesticides, synthetic rubber, and plastics has risen more than 100-fold. Thus, it does not seem that industry can be made the scapegoat for the cancers that are common at the moment."

Now, since cancer death rates have not increased after the production of hazardous industrial chemicals rose 100-fold, and since cancer death rates have not decreased after the implementation of procedures to diminish exposure to hazardous industrial chemicals, there cannot be any conclusion other than that industrial chemicals are an insignificant factor in the causation of cancer.

It is instructive, in this connection, to compare the U.S. age-adjusted cancer mortality rates—which rose from 162.2 per 100,000 population in 1975 to 170.7 in 1984—with those of an essentially agricultural country with little chemical industry, such as New Zealand. Using equivalent figures—limited, however, to the male population—the New Zealand rates rose from 168 in 1973 to 174 in 1983. There is, certainly, no noticeable effect brought about by the U.S. chemical industry.

In conclusion, changes in strategy in the war against cancer are imperative. Research emphasis must be shifted from hazardous chemical carcinogens to the dietary and lifestyle changes needed to strengthen our immune system.

Ernest W. Volkmann
ACS Emeritus Member
Ligonier, Pa.

Periodic table long form

SIR: As William B. Jensen (C&EN, Aug. 17, 1987, page 2) stated, any labeling or shaping of the periodic table should perform a useful function, such as to locate elements or impart some pertinent information. The original numbering systems were devised by various authors in an attempt to defend the empirical structure of their tables.

Mendeleev justified his form of the table, particularly the gaps he left and the reversal of some of the elements as listed by atomic mass, by reference to the formula of the highest oxide of the elements and labeled the group in which he placed each element with the number of moles of oxygen that combined with 2 moles of that element in its highest oxide.

Correction

• Jan. 11, page 24: In the review of the book, "A Killing Wind: Inside Union Carbide and the Bhopal Catastrophe," the reviewer stated that the book's author, Dan Kurzman, was in error in attributing water as heavier than methyl isocyanate (MIC). Kurzman is in fact correct.

FEDERAL R&D BUDGET: Science gains despite deficit flap

Last week President Reagan sent his eighth and, for all practical purposes, his final budget proposal to Congress. Some of the government's R&D agencies, most notably the National Science Foundation, fare much better than average in a budget that is essentially no larger than the current year's budget, taking inflation into account.

The budget proposal calls for total government spending of $1.094 trillion in fiscal 1989, an increase of 4% over current levels, and a deficit of $129.5 billion. It is a no-growth budget, if the Administration's economists are right and the inflation rate hovers around 3.5% in 1989. Experiencing big growth, however, is science, underscored by a 20% rise in NSF's budget.

"In formulating this budget," Reagan told Congress, "I have endeavored to meet national priorities while keeping to the terms of the bipartisan budget agreement" worked out between Congress and the Administration last November. That agreement essentially limits increases in discretionary domestic spending to 2% and in defense spending to 3%. Among the "urgent national priorities" receiving larger than allowed increases is R&D.

Total federal obligations for R&D are slated to rise 4% to $62.5 billion. And, in line with the budget agreement, funding for civilian R&D, up 8% to $23.7 billion, would grow at a faster rate than defense R&D, up 2% to $38.8 billion, for the first time in many years.

Obligations for basic research would rise 6% to $10.3 billion. Within that total, federal support for academic R&D is estimated to increase 13% in 1989 to a total of $9.2 billion. This, budget documents note, would represent a real increase of 54% over the term of the Reagan Administration.

A number of science and technology issues are among Reagan's top priorities as delineated in the budget message. For example:

• "I would provide $11.5 billion for space programs, including essential funding for continued development of America's first permanently manned space station.

• "I also recommend $363 million in 1989 to initiate construction of the Superconducting Super Collider, including $283 million for construction and $60 million for supporting research and development. The SSC as currently envisaged will be the largest pure science project ever undertaken.

• "To attack the scourge of AIDS [acquired immune deficiency syndrome], I propose $2 billion for research, treatment, and education in 1989—a 38% increase over the 1988 level and more than double the federal government's efforts in 1987."

And the Administration is holding to the commitment it made last year to double funding for NSF within five years, However, because of severe fiscal 1988 budget cuts, the target date is now 1994, rather than the original 1993. As a first installment, it is asking for a 20%, $303 million increase to $1.8 billion for NSF in fiscal 1989. If things go as the Administration wishes in other areas, the National Aeronautics & Space Administration's R&D budget will be up 13%, or $637 million, to $5.4 billion, and the Department of Health & Human Services' R&D budget will be up 11%, or $764 million, to $7.9 billion.

Not all is rosy for science, however. Funding for the National Institutes of Health would decline slightly, just over 1%, to $6.2 billion. R&D funding for the Department of Energy's energy programs also would be down about 1% to $2 billion, for the Department of Interior down 5% to $396 million, and for the Department of Agriculture down 3% to $985 million.

Taking the biggest hit are the Department of Commerce's research programs, funding for which would be down 24%, or $96 million, to $312 million. The Administration once again wants to eliminate the National Oceanic & Atmospheric Administration's underseas research and sea grant college programs.

Congress hasn't gone along with those ideas in the past and isn't likely to do so this year either. However, insofar as this budget does adhere to the November budget agreement, it may be difficult for Congress to make wholesale changes in priorities and spending levels as it has in other years, even though, as Reagan put it, "This budget does not fully reflect my priorities, nor, presumably, those of any particular member of Congress."

Janice Long, Washington

NSF is big winner in 1989 R&D budget that is up 4% overall

$ Millions	1989[a]	1988[a]	1987[b]	% change 1988–89
Defense	$38,787	$37,899	$36,088	2%
HHS	7,938	7,174	6,643	11
NASA	5,416	4,779	3,787	13
Energy	5,165	5,071	4,724	2
NSF	1,827	1,524	1,464	20
Agriculture	985	1,018	948	−3
Interior	396	419	403	−5
EPA	374	350	348	7
Transportation	317	325	322	−2
Commerce	312	408	405	−24
All other	1,000	984	960	2
TOTAL	$62,517	$59,951	$56,090	4%

Note: Obligations. a Estimate. b Actual. Source: Office of Management & Budget

Chemical Earnings Score Huge Gains in Fourth Quarter

William J. Storck, C&EN New York

It was not so long ago that many observers thought the U.S. chemical industry was all but dead. Huge in volume and highly cyclical, petrochemicals especially came in for their share of blame. Production of these products, many said, would migrate to areas of the world where feedstock costs were low, leaving the U.S. with just a modest petrochemical industry.

How times do change—and quickly. Spurred by U.S. and foreign demand, U.S. petrochemical producers helped push the chemical industry to new levels of profits in last year's fourth quarter, to the point that now there are finally plans to build some new U.S. capacity.

Performance by the chemical industry in the fourth quarter was nothing short of outstanding. Chemical executives had said that the quarter was going to be good for their firms, but probably few realized just how good overall it was actually going to turn out. Among a representative group of the largest chemical companies, sales increased 20% from year-earlier levels and earnings soared a phenomenal 93%.

This outdid by far any of the other industry categories charted by C&EN. Among oil companies that produce chemicals, earnings rose 47% (from fourth-quarter 1986) on a 21% sales increase. Pharmaceutical firms' earnings climbed 13% on an 11% increase in sales. And among diversified companies with chemical operations, earnings rose 48% and sales improved 17%.

Chemical industry leaders cite

Chemical industry leaders for the fourth quarter . . .

Sales

Rank 1987		$ Millions	Rank 1986
1	Dow Chemical	$3579.0	1
2	Monsanto	1846.0	3
3	Union Carbide	1845.0	2
4	W. R. Grace	1304.8	4
5	American Cyanamid	1025.0	5
6	Quantum Chemical	742.3	7
7	Hercules	678.0	6
8	Air Products	585.9	8
9	Rohm & Haas	531.9	10
10	Arco Chemical	507.0	nr

Earnings

	$ Millions	Rank 1986
Dow Chemical	$354.0	1
Arco Chemical	72.0	nr
Quantum Chemical	65.1	7
American Cyanamid	60.2	2
Air Products	55.4	6
W. R. Grace	53.3	30
Ethyl	52.9	4
Hercules	48.8	3
Monsanto	44.0	9
Rohm & Haas	36.7	5

Profitability

	Earnings as % of sales	Rank 1986
Georgia Gulf	17.4%	nr
Vista Chemical	14.2	nr
Arco Chemical	14.2	nr
International Flavors	11.9	2
Ethyl	11.2	1
Betz Laboratories	10.1	4
Dow Chemical	9.9	14
Nalco Chemical	9.6	3
Air Products	9.4	10
Loctite	9.3	6

. . . and for full-year 1987

Sales

Rank 1987		$ Millions	Rank 1986
1	Dow Chemical	$13,377.0	1
2	Monsanto	7,639.0	2
3	Union Carbide	6,914.0	3
4	W. R. Grace	4,515.4	5
5	American Cyanamid	4,166.1	4
6	Hercules	2,693.0	6
7	Quantum Chemical	2,566.8	11
8	Rohm & Haas	2,203.2	8
9	Air Products	2,184.3	9
10	Arco Chemical	1,952.0	nr

Earnings

	$ Millions	Rank 1986
Dow Chemical	$1245.0	1
Monsanto	436.0	2
Arco Chemical	267.0	nr
American Cyanamid	264.0	4
Union Carbide	232.0	9
Hercules	209.3	3
Rohm & Haas	195.5	6
Ethyl	193.3	5
Air Products	176.5	8
Quantum Chemical	143.6	16

Profitability

	Earnings as % of sales	Rank 1986
International Flavors	14.3%	1
Arco Chemical	13.7	nr
Georgia Gulf	13.0	nr
Ethyl	11.2	2
Betz Laboratories	10.5	3
Vista Chemical	10.0	nr
Loctite	9.7	6
Nalco Chemical	9.5	7
Dow Chemical	9.3	13
Rohm & Haas	8.9	8

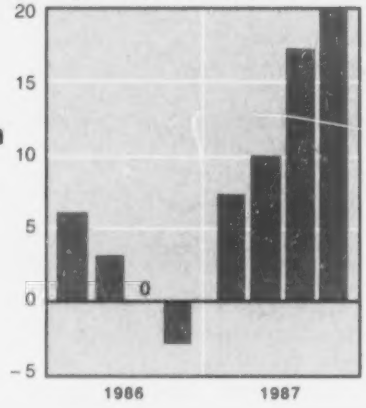
Note: Based on 30 companies listed on page 12. nr = not ranked.

Chemical industry 1987 fourth-quarter results

- Sales increased 20%
- Earnings skyrocketed
- Profit margins stayed high
- Production climbed 7.2%
- Prices rose nearly 7%

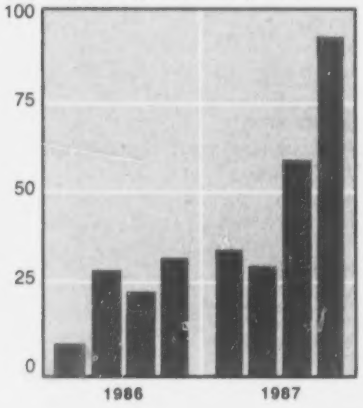
Sales

% change from year-earlier quarter



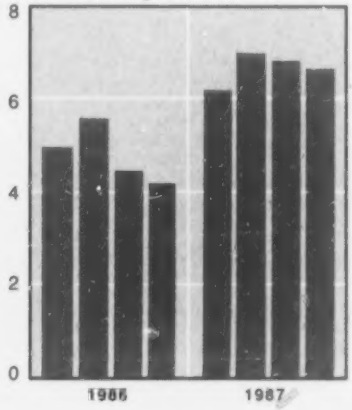
Earnings

% change from year-earlier quarter



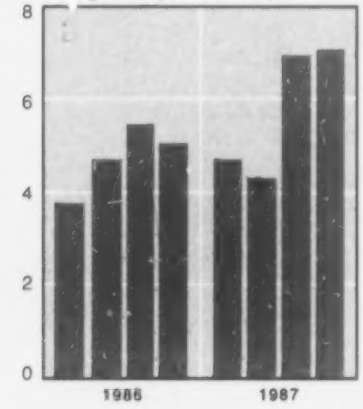
Profit margins

After-tax earnings as % of sales



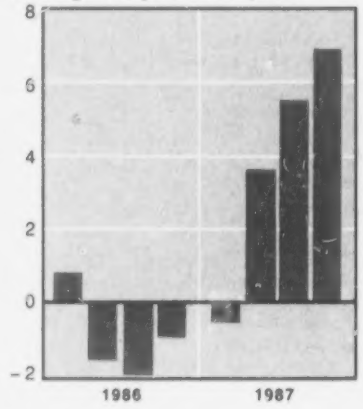
Production

% change from year-earlier quarter



Prices

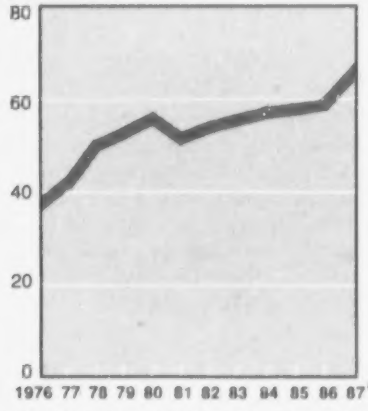
% change from year-earlier quarter



Sales in 1987 rose 14% and earnings shot up 50%, pushing profit margins up to 6.7%

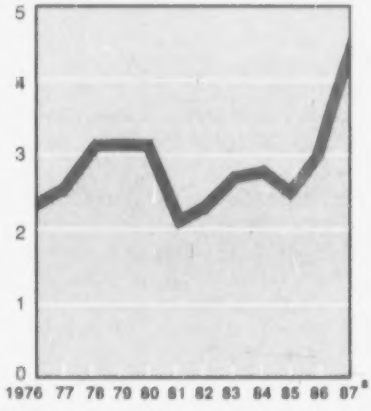
Annual sales

$ Billions



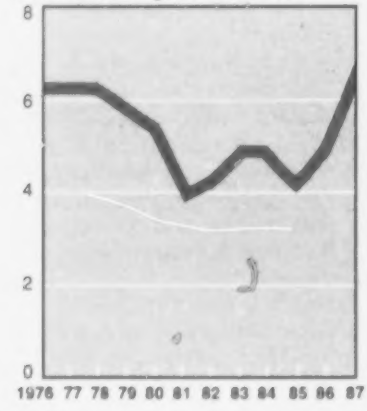
Annual earnings

$ Billions



Annual profit margins

After-tax earnings as % of sales



Note: All sales, earnings, and profit margin data are based on combined results of 30 companies listed on page 12. e-C&EN estimates.

Earnings nearly doubled at major U.S. chemical firms in fourth quarter

	FOURTH-QUARTER 1987						FULL-YEAR 1987				NINE-MONTHS 1987	
	Sales ($ millions)	Earnings[a]	Change from 1986 Sales	Change from 1986 Earnings[a]	Profit margin[b] 1987	Profit margin[b] 1986	Sales ($ millions)	Earnings[a]	Change from 1986 Sales	Change from 1986 Earnings[a]	Profit margin[b] 1987	Profit margin[b] 1986
Air Products[c]	$ 585.9	$ 55.4	10%	56%	9.4%	6.6%	$ 2,184.3	$ 176.5	7%	27%	8.1%	6.8%
American Cyanamid[c]	1,025.3	60.2	8	16	5.9	5.5	4,166.1	264.0	9	30	6.3	5.3
Arco Chemical[c]	507.0	72.0	27	148	14.2	7.3	1,952.0	267.0	27	87	13.7	9.3
Aristech	241.9	21.4	37	88	8.8	6.5	918.8	69.7	22	59	7.6	5.8
B. F. Goodrich[c]	na	na	na	na	na	2.6	na	na	na	na	na	0.5
Betz Laboratories	99.7	10.0	17	40	10.1	8.4	385.9	40.6	12	14	10.5	10.3
Cabot[c]	386.7	16.2	12	−14	4.2	5.4	1,381.3	56.1	6	−9	4.1	4.7
Chemed	99.7	4.7	7	26	4.7	4.1	391.0	20.4	9	23	5.2	4.6
Crompton & Knowles	58.3	3.1	8	43	5.3	4.0	237.5	11.8	11	32	4.9	4.2
Dow Chemical[c]	3,579.0	354.0	28	109	9.9	6.1	13,377.0	1245.0	20	68	9.3	6.7
Ethyl[c]	470.6	52.9	21	16	11.2	11.7	1,720.3	193.3	9	9	11.2	11.3
First Mississippi	85.8	3.1	38	269	3.6	1.3	326.2	20.9	32	330	6.4	2.0
Georgia Gulf	201.9	35.1	39	205	17.4	7.9	707.4	91.7	21	134	13.0	6.7
H. B. Fuller	153.2	7.3	10	41	4.8	3.7	597.1	25.8	13	36	4.3	3.6
Hercules[c]	678.0	48.8	6	3	7.2	7.4	2,693.0	209.3	3	−8	7.8	8.7
International Flavors	179.3	21.3	23	26	11.9	11.6	745.9	107.0	20	25	14.3	13.8
International Minerals[c]	460.4	34.5	21	def	7.5	def	1,801.6	75.2	15	def	4.2	def
Loctite	103.2	9.6	27	51	9.3	7.8	383.4	37.1	31	46	9.7	8.7
Lubrizol	na	na	na	na	na	6.3	na	na	na	na	na	8.0
Monsanto[c]	1,846.0	44.0	18	91	2.4	1.5	7,639.0	436.0	11	19	5.7	5.3
Nalco Chemical	230.7	22.0	22	37	9.6	8.5	841.9	80.3	14	26	9.5	8.7
Olin[c]	503.0	16.0	21	100	3.2	1.9	1,930.0	78.0	11	34	4.0	3.3
Pennwalt	300.5	17.0	14	45	5.7	4.4	1,142.8	53.8	9	6	4.7	4.8
Petrolite	78.0	3.7	18	4	4.7	5.4	278.6	15.4	0	−12	5.5	6.2
Quantum Chemical[c]	742.3	65.1	37	121	8.8	5.4	2,566.8	143.6	48	161	5.6	3.2
Rohm & Haas[c]	531.9	36.7	14	2	6.9	7.6	2,203.2	195.5	7	15	8.9	8.2
Union Carbide[c]	1,845.0	23.0	16	64	1.2	0.9	6,914.0	232.0	9	78	3.4	2.0
Vista Chemical	178.8	25.5	37	196	14.2	6.6	657.5	65.5	17	71	10.0	6.8
W. R. Grace[c]	1,304.8	53.3	23	def	4.1	def	4,515.4	142.0	21	def	3.1	def
Witco	368.4	17.8	13	8	4.8	5.1	1,427.7	68.1	5	4	4.8	4.8
Total 14 larger firms	**$14,465.9**	**$ 932.1**	**20%**	**100%**	**6.4%**	**3.9%**	**$55,044.0**	**$3713.5**	**15%**	**53%**	**6.7%**	**5.0%**
Smaller 14 firms	**$ 2,379.4**	**$ 201.6**	**22%**	**56%**	**8.5%**	**6.2%**	**$ 9,041.5**	**$ 708.0**	**14%**	**38%**	**7.8%**	**6.5%**
GRAND TOTAL	**$16,845.3**	**$1133.7**	**20%**	**93%**	**6.7%**	**4.2%**	**$64,085.5**	**$4421.5**	**14%**	**50%**	**6.9%**	**5.3%**

a After-tax earnings from continuing operations excluding significant nonrecurring and extraordinary items. b After-tax earnings as a percentage of sales. c One of the 15 largest companies. na = not available. def = deficit.

many reasons for the vastly improved performance. Some say that they have further reduced operating costs during the past year. Others credit a further shucking of marginally profitable businesses. Still others point to new product lines. But, in the final analysis, most agree that the primary reason was that business was good.

During the quarter, U.S. chemical production was up an estimated 7% over the previous year's final three months, and prices increased almost as much, according to government data. Price increases were, of course, largely driven by production. Capacity utilization in the industry was very high—more than 100% for some products. This high capacity use increased operating efficiencies and the tight supply-demand situation paved the way to price rises, thus hiking profitability.

For instance, Georgia Gulf's chairman, president, and chief executive officer James R. Kuse says: "Sales demand actually improved during the fourth quarter, allowing our plants to operate at or near capacity, helping to reduce unit costs. This, coupled with higher sales prices, resulted in substantially improved margins for most products."

Aristech chairman and chief executive officer Thomas Marshall says, "Aristech's first year was characterized by a number of highly positive factors for our business. Demand for our major products remained strong throughout the year. The supply-demand balance was such that many of our plants and much of the industry operated at or near capacity for essentially the entire year. This was especially true in polypropylene and industrial chemicals."

The upshot was vastly improved results. Among 28 of the 30 largest chemical companies regularly sur-

Earnings improved dramatically at oil, pharmaceutical, and diversified companies

	FOURTH-QUARTER 1987						FULL-YEAR 1987					
	Sales	Earnings[a]	Change from 1986		Profit margin[b]		Sales	Earnings[a]	Change from 1986		Profit margin[b]	
	($ millions)		Sales	Earnings	1987	1986	($ millions)		Sales	Earnings	1987	1986
OIL AND GAS COMPANIES												
American Petrofina	$ 671.6	$ 13.6	34%	170%	2.0%	1.0%	$ 2,484.0	$ 83.3	27%	def	3.4%	def
Amoco	5,916.0	377.0	22	128	6.4	3.4	22,391.0	1360.0	11	50%	6.1	4.5%
Ashland	2,000.0	40.0	25	48	2.0	1.7	7,613.0	130.0	11	9	1.7	1.7
Chevron	7,300.0	220.0	26	−4	3.0	4.0	29,100.0	1007.0	7	41	3.5	2.6
Exxon	22,586.0	1556.0	18	5	6.9	7.7	84,116.0	4841.0	10	−10	5.8	7.0
Kerr-McGee	640.7	14.7	9	67	2.3	1.5	2,607.6	84.0	3	245	3.2	1.0
Mobil	15,662.0	529.0	25	161	3.4	1.6	56,446.0	1404.0	13	0	2.5	2.8
Occidental Petroleum	4,389.0	23.0	5	15	0.5	0.5	17,096.0	184.0	11	7	1.1	1.1
Phillips Petroleum	2,932.0	−10.0	23	def	def	0.2	10,917.0	−8.0	9	def	def	5.8
Shell Oil	5,888.0	436.0	30	1717	7.4	0.5	21,222.0	1230.0	22	39	5.8	5.1
Sun Co.	2,610.0	83.0	16	19	3.2	3.1	9,820.0	348.0	−7	−10	3.5	3.6
Texaco	9,400.0	138.0	21	176	1.5	0.6	35,300.0	493.0	8	−32	1.4	2.2
PHARMACEUTICAL COMPANIES												
Abbott Labs	281.4	22.5	4	214	8.0	2.7	928.8	54.3	10	1551	5.9	0.4
American Home Products	1,213.4	215.2	2	8	17.7	16.7	5,028.3	845.1	2	9	16.8	15.8
Baxter Travenol	1,647.0	90.0	11	43	5.5	4.3	6,223.0	323.0	9	68	5.2	3.4
Becton Dickinson	397.4	24.5	16	33	6.2	5.3	1,635.8	139.1	18	21	8.5	8.3
Bristol-Myers	1,360.6	174.1	13	15	12.8	12.6	5,401.2	709.6	12	20	13.1	12.2
Eli Lilly	904.9	191.6	6	1	21.2	22.1	3,643.8	931.9	10	10	25.6	25.4
Merck	1,394.4	232.4	21	35	16.7	15.0	5,061.3	906.4	23	34	17.9	16.4
Pfizer	1,275.2	136.6	10	−14	10.7	13.6	4,919.8	690.2	10	5	14.0	14.7
Schering-Plough	663.3	75.2	11	26	11.3	10.0	2,699.3	316.4	13	19	11.7	11.1
SmithKline Beckman	1,198.7	141.9	15	−4	11.8	14.1	4,328.8	570.1	16	9	13.2	13.9
Squibb	592.6	84.6	15	26	14.3	13.1	2,156.5	358.4	21	36	16.6	14.8
Sterling Drug	592.4	51.8	13	15	8.7	8.6	2,300.9	330.0	16	10	14.3	15.1
Upjohn	649.7	71.0	11	10	10.9	10.9	2,521.0	305.0	11	21	12.1	11.1
Warner Lambert	909.7	66.3	12	17	7.3	7.0	3,484.7	295.8	12	−4	8.5	10.0
DIVERSIFIED MANUFACTURERS												
Allied-Signal	2,954.0	77.0	17	64	2.6	1.9	11,116.0	515.0	12	−4	4.6	5.5
Borden	1,804.2	81.3	33	18	4.5	5.1	6,514.4	267.1	30	20	4.1	4.5
Du Pont	7,941.0	439.0	19	31	5.5	5.0	30,468.0	1786.0	12	17	5.9	5.6
Eastman Kodak	3,529.0	242.0	17	227	6.9	2.4	13,305.0	1178.0	15	15	8.9	8.9
Engelhard	728.1	15.7	4	10	2.2	2.0	2,479.2	72.8	8	37	2.9	2.3
Ferro	232.9	11.2	24	37	4.8	4.3	871.1	33.5	20	35	3.8	3.4
FMC	856.3	5.5	10	−89	0.6	6.5	3,139.1	96.2	5	−25	3.1	4.3
GAF	209.1	19.5	15	2	9.3	10.5	836.9	100.1	11	24	12.0	10.7
Kaiser Tech[c]	456.4	28.0	−6	def	6.1	def	1,987.2	13.4	1	def	0.7	def
Koppers	420.4	16.1	14	5	3.8	4.2	1,515.7	70.2	9	11	4.6	4.5
3M	2,375.0	216.0	12	17	9.1	8.8	9,429.0	918.0	10	18	9.7	9.1
Morton Thiokol	584.8	39.3	27	21	6.7	7.0	1,008.7	79.9	11	22	7.9	7.2
PPG Industries	1,330.0	96.5	11	32	7.3	6.1	5,180.0	377.1	10	19	7.3	6.7
Tyler	283.2	5.0	20	3622	1.8	0.1	1,099.5	16.8	14	41	1.5	1.2
Vulcan Materials	246.3	28.5	25	85	11.6	7.8	923.3	114.5	15	25	12.4	11.4

a After-tax earnings from operations excluding significant nonrecurring and extraordinary items. b After-tax earnings as a percentage of sales. c Includes some nonrecurring or extraordinary items. **def** = deficit.

veyed by C&EN, chemical sales gained 20% from fourth-quarter 1986 to a total of $16.8 billion. Earnings from continuing operations, excluding major nonrecurring and extraordinary items, rose 93% to a total $1.13 billion. The average profit margin (after-tax earnings as a percentage of sales) for this group of companies reached 6.7%, up from just 4.2% in the fourth quarter of 1986.

The increase in earnings at the larger companies, more heavily dominated by basic chemicals, was even more impressive. Among the 14 larger companies in the group, combined earnings totaled $932 million, double the total a year earlier. Combined sales increased 20% to $14.5 billion. Profit margins among these firms averaged 6.4%, an increase from 3.9% a year earlier.

For the 14 smaller firms in the group, which are more oriented toward value-added chemicals, earnings increased much less, but profitability continued higher. These companies' combined earnings increased 66% to a total $202 million on a sales jump of 22% to $2.38 billion. The average profit margin for these firms increased to 8.5% from 6.2% in fourth-quarter 1986.

For the full year, the story was much the same. Combined earnings for the 28 chemical companies rose 50% from full-year 1986 to a total of $4.42 billion. Combined sales rose 14% to $64.1 billion. Thus profit margins rose to an average 6.9% from 5.3% for all of 1986.

For the 14 larger companies, earnings increased 53% to a combined $3.71 billion on a sales rise of 15% to $55.0 billion. For the 14 smaller firms, combined earnings gained 38% to $708 million on a 14% sales increase to $9.04 billion.

But again, the smaller companies bested the larger firms in profitability. Profit margins for the 14 smaller firms increased to an average 7.8% from 6.5% a year earlier; profit margins for the 14 larger firms climbed to 6.7% from 5.0%.

Company officials commenting on the earnings performance are almost unanimous in their praise of the fourth quarter and the year. Rohm & Haas chairman Vincent L. Gregory Jr. says: "1987 ended in high gear. Business was strong in nearly every product line and across all geographic regions. The year-to-year sales growth for the fourth quarter was the best of any quarter in 1987. External economic conditions in the chemical industry were favorable around the world, and the increased acceptance of our products was gratifying. Most of the nonagricultural businesses operated at high levels. Their volume growth enabled us to achieve improved profit performance for the quarter and establish a record for the full year."

For Arco Chemical, recently spun off from Atlantic Richfield, president and chief executive officer Harold A. Sorgenti comments that "The overall improvement in gross profit is attributable to increased sales volumes and increased margins. Sales volumes of propylene oxide and derivatives and oxygenated fuels increased 18% each. Worldwide propylene oxide demand increased approximately 7% in 1987 over 1986."

Olin president and chief executive officer John W. Johnstone Jr. says: "Operating income doubled in the quarter and was up 40% for the full year as chemicals produced their best operating results in over a decade."

Ethyl's chairman Floyd D. Gottwald Jr. notes that, "Aided by improved fourth-quarter results in almost every segment, 1987 was a banner year for Ethyl. Plastics continued to lag behind 1986. We are particularly encouraged by the performance of our chemicals operations, with bromine chemicals showing notable strength."

Frank P. Popoff, president and chief executive officer at Dow Chemical, says: "Basic chemicals and plastics continued their outstanding performance in the fourth quarter and for the year. In 1987, polystyrene became the first Dow product to surpass $1 billion in sales. Polyethylene also had a significant volume increase, giving rise to the expectation that 1988 business will continue to be strong for both these plastics."

Just what 1988 will bring for the chemical industry is of great concern to industry leaders. Most seem to be optimistic. For instance:

- Olin's Johnstone: "Sales and earnings momentum for the fourth quarter is continuing into the first quarter of 1988. Demand is strong for chemicals and metals, with important price increases in place."
- Aristech's Marshall: "Based on market expectations, anticipated plant utilization rates, and capacity improvements, we expect to maintain the momentum in growth, profitability, and financial strength with which we concluded 1987."
- Georgia Gulf's Kuse: "We have not seen any sign of a slowdown in the markets we serve, and based on existing orders and inventories, we have reason to be bullish about the company's performance for 1988."

However, given talk among economists and Wall Street analysts of a slowdown in the economy, there are varying degrees of caution in what the chemical executives say about 1988. A sampling:

- Air Products & Chemicals chairman Dexter F. Baker: "[Our] outlook for profit growth for the year is clearly positive, although tempered by the uncertain current outlook for world economies."
- Du Pont chairman and chief executive officer Richard E. Heckert: "We expect 1988 to be a challenging year given the uncertainty surrounding the domestic and world economies. However, we are confident that the company is well positioned to compete effectively in this environment."
- Hercules chairman and chief executive officer David S. Hollingsworth: "As 1988 begins, housing starts and consumer spending trends were weakening somewhat, while the manufacturing segment remained strong due to a positive momentum in export shipments. Although Hercules has had no indication of an overall business downturn, we approach 1988 with a certain degree of caution. Nonetheless, we are anticipating a year of improvement in 1988."
- Rohm & Haas' Gregory: "Conditions in the chemical industry are the best that they have been in years. As long as the economy holds together, we should continue to show earnings gains. When the inevitable downturn comes, we, along with all industrial companies, will face tough sledding." □